

TITLE: HIGH SOLIDS MODULE

FIELD OF THE INVENTION

The present invention relates to membrane filtration systems used with high solids feed and, more particularly, to a method and apparatus for improving the filtration efficiency of such systems by providing an improved cleaning system for the membranes.

BACKGROUND ART

In a membrane filtration process, the method used to physically clean membranes is of vital importance. An efficient membrane cleaning strategy can maintain a stable permeability of the membrane and reduce the frequency of chemical cleans. A commonly used method to physically clean membranes is a backwash (also called "backflush" or "backpulse") with the permeate/filtrate or a gas. The backwash method is typically used to eject solids blocking the membrane pores and partly dislodge the cake that may have formed on the membrane surface. In a system exposed to a feed containing a high concentration of solids, the fouling occurs more quickly and more severely, in particular, where membranes are densely packed in a module.

Backwash with pressurized gas has proved a very efficient cleaning method and is now widely used in the field of microfiltration processes. The limitation to this method is the membrane pore size. Backwash of membranes with permeate has no limitations to the pore size, but the backwash efficiency is generally lower than gas backwash and the transmembrane pressure (TMP) recovery not enough to offset the fouling rate. Further means are employed to enhance the backwash efficiency, such as dosing chemicals to the backwash permeate, or in combination with gas scrubbing.

Maruyama et al in Japanese Patent No. JP2031200 discloses a hollow fibre membrane backwashing method. The method involves the following sequence: stop filtration, air-scour membrane, fill the membrane vessel, backwash with permeate under pressurized air and drain the waste. This
5 procedure is repeated to achieve a higher efficiency. Sunaoka et al in a United States Patent No. 5,209,852 describes a process for scrubbing hollow fibre membranes in modules. This process is composed of a two-stage air scrubbing and draining to clean the membranes.

In order to minimise footprint and cost, membrane modules are typically
10 manufactured with a high packing density of membranes, usually in the form of fibres. This increases the amount of membrane area for filtration within a module. However, the higher the packing density the more difficult it is to effectively flush solids captured during the filtration process from the membrane bundle. Therefore, improvement in the efficiency of solids removal during
15 backwash allows either higher solids levels to be processed, or higher membrane packing densities to be used, reducing the cost of treatment.

In prior art fibre membrane systems, removal of solids is usually effected by sweeping with feedwater from one end of the module to the other and then out of the module through a side exit port. In this case, solids are first swept
20 along the fibres to the exit end of the module, but must then cross the fibre bundle to exit the module. In high solids applications this requirement for the flow to change direction and pass perpendicular to the fibre bundle to exit the module can lead to accumulation of solids near the exit due to the tendency for the fibres to act like a string filter and capture or hinder the exit of solids from the
25 module at this point.

DISCLOSURE OF THE INVENTION

The present invention seeks to overcome or at least ameliorate one or more of the disadvantages of the prior art or at least provide a useful alternative.

According to one aspect, the present invention provides a method of
5 cleaning a membrane filtration module, said module including one or more
membranes located in a feed-containing vessel and extending longitudinally
between vertically spaced upper and lower headers into which the ends of the
membranes are potted, the membranes having a permeable wall which is
subjected to a filtration operation wherein feed containing contaminant matter is
10 applied to one side of the membrane wall and filtrate is withdrawn from the other
side of the membrane wall, at least one of said upper and/or lower headers
having one or more openings therein, the method including:

- a) suspending the filtration operation;
- b) performing a cleaning process on the membrane wall to dislodge
15 contaminant matter therefrom into liquid surrounding the membrane;
- c) performing a sweep of the feed-containing vessel substantially
parallel to the longitudinally extending membranes to remove the liquid
containing the dislodged contaminant matter, at least in part, through the
openings in the header; and
- 20 d) recommencing the filtration operation.

For further preference, the openings are provided in the lower header and
filtrate is withdrawn from the upper header. Preferably, the openings may also
be used to introduce gas into the module to produce bubbles for scouring the
surface of the membranes during said cleaning process. The sweep may be

performed concurrently with the cleaning process. Preferably, the sweep is a high velocity sweep.

The present invention provides for holes or openings in one of the module pots so that solids swept along the membranes during the backwash process
5 continue to flow parallel to the membranes as they exit the module. The requirement for the solids to cross over the fibre bundle to exit at a side port is substantially reduced or eliminated.

The same concept could be applied to submerged membranes operated in an open tank. In the prior art solids are typically removed by draining the
10 tank. As the feed containing the solids drains from the module it must change direction near the bottom to flow out of the module and drain from the tank. By providing holes or openings in the bottom of the module, solids can continue to flow substantially parallel to the fibres as they pass out of the module. This uninterrupted flow provides for more efficient removal of solid from the module
15 and tank.

According to a further aspect, the present provides a method of cleaning a membrane filtration module, said module including one or more membranes located in a feed-containing vessel and extending vertically from an upper header into which proximal ends of the membranes are potted, the membranes
20 having a permeable wall which is subjected to a filtration operation wherein feed containing contaminant matter is applied to one side of the membrane wall and filtrate is withdrawn from the other side of the membrane wall, the method including:

- a) suspending the filtration operation;

b) performing a cleaning process on the membrane wall to dislodge contaminant matter therefrom into liquid surrounding the membrane;

c) performing a sweep of the feed-containing vessel substantially parallel to the vertically extending membranes to remove the liquid containing the dislodged contaminant matter, at least in part, through an opening in the module beneath said membranes; and

d) recommencing the filtration operation.

BRIEF DESCRIPTION OF THE DRAWING

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a schematic sectional view of a membrane module according to one embodiment; and

Figure 2 shows a schematic sectional view of a membrane module according to further embodiment.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the Figure 1, the filtration module 5 is mounted within a housing vessel 6 which contains the feed to be filtered. The filtration module 5 contains a bundle or bundles of hollow fibre membranes 7 extending between upper and lower headers 8 and 9, respectively. The lower header 9 is provided with a number of openings 10 communicating with the interior of the fibre bundle and a collection chamber 11 having an inlet/outlet port 12. Feed is supplied through ports 13 and 14 under the control of valves AV1 and AV2.

Permeate/filtrate is withdrawn through chamber 15 and port 16 under control of valve AV3. A backwash may also be applied through port 16 under the control of valve AV4.

In use, solids accumulated within the module 5 following filtration and backwash are flushed or swept from the module 5 through the openings 10 by opening port 12 and applying a suitable pressure to the feed within the module 5. Port 12 may also be used to supply gas to openings 10 to provide scouring
5 bubbles within the module 5 to assist cleaning of the fibre membrane surfaces.

Figure 2 shows a similar arrangement to Figure 1, however, in this embodiment the hollow fibre membranes 7 are suspended vertically from the upper header 8 and are not potted at their lower distal ends 17. The distal ends 17 of each fibre membrane 7 are closed and filtrate withdrawn through the upper
10 header 8. Backwash in this embodiment is flushed or swept through port 12.

It will be appreciated that further embodiments and exemplifications of the invention are possible with departing from the spirit or scope of the invention described.